THE MISSION RANGE, MONTANA

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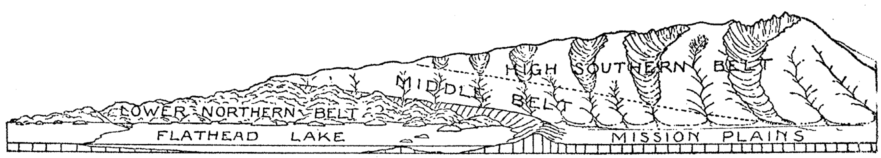
The Mission Range, one of the smaller members of the Rocky Mountains in western Montana, believed to be composed of deformed rocks chiefly quartzites, has the appearance of a gently tilted and moderately dissected fault block, trending north and south and about 70 miles in length. The steeper face, probably representing the battered fault scarp, looks to the west. At the low northern end of the range, the gently undulating crest emerges from the surrounding plains which are about 3000 feet in altitude, and rises slowly southward, reaching a height of 9500 feet near its abrupt southern end, thus gaining a local relief of 6500 feet. The eastern side of the range is said to slope more gently than the western face. The nearly even crest and long eastern



slope suggest that the mountain mass is an upraised fragment of a former worn-down mountain region.

The western face of the range, which I saw during a Shaler Memorial study of another Montana problem in 1913, may be divided as in the above figure into three oblique belts by two nearly parallel, south-dipping planes, about 1000 feet apart. The middle belt includes smoothly rounded summits and large-textured, full-bodied, waste-covered spurs, between wide-spaced, steep-pitching, apparently consequent ravines of normal erosion. All the high-reaching valleys of the southern belt expand in cirques of local glaciation at their heads, and continue downwards in narrowing troughs with oversteepened walls. These features are best developed at the high southern end of the range; there the cirques are huge cliff-rimmed cavities, strongly expanded southward; the mountain crest is sharpened to Alpine arêtes between opposing cirque walls; the long troughs, encroaching broadly on the normal forms of the rounded spurs, reach the foot of the mountains; and terminal moraines advance a short distance upon the piedmont plain, sometimes enclosing a lake in their loop. More than a score of glacial cirques and troughs may be counted, but their strength diminishes as the range

crest lowers northward, and the northernmost cirques are of small dimensions, faintly developed, and reach only a few hundred feet down from the valley heads. The limiting plane which touches the lower end of the troughs rises slowly northward from the base of the range at the southern end and reaches the crest of the range north of mid-length.

The lower northern belt of the range shows innumerable bare crags, knobs, cliffs and ledges of small texture, due to scouring and plucking by the terminal portion of a broad and overwhelming glacier of Canadian orig'n. The limiting plane, marking the height of the invading glacier, touches the range crest about a quarter length from its low northern end and descends to the range base south of mid-length. The northern quarter of the range, lying entirely beneath this limiting plane, exhibits glaciated forms in a minutely irregular crest and a disorderly slope of scoured and plucked hills and hollows, all of less and less height northward, until the last visible knobs, deeply scored and channeled and more or less detached from one another, rise only 100 feet or so above the surrounding intermont plain of glacial gravels and silts, diversified by low morainic hills, which presumably conceals a farther northward extension of the range crest. The second quarter of the range shows similar small-textured forms up to the limiting plane, but above it the mountain crest and slope retain the simpler, large-textured forms of normal erosion, until, near mid-length, the valley heads begin to show the cirques of the high southern belt. Through this second quarter each normal valley is barred by a morainic embankment on the line of the limiting plane, and below the plane each spur is imperfectly truncated in a bold and rugged slope which presents a tumult of rocky cliffs and ledges, descending abruptly and without well-defined valley reentrants to the waters of Flathead Lake. The apex height of the rugged spur facets and the altitude of the somewhat lower morainic embankments decrease slowly and systematically southward; the facets become smaller and less continuous with one another; the embankments become longer, larger, and more nearly continuous, until they curve away from the range base and form a noble terminal moraine, 400 or 500 feet in height and a mile or more wide, which swings westward across the intermont depression and separates Flathead Lake on its northern concave side from a broad till plain of earlier glaciation on its southern convex side.

It is to the long and gradual southward rise of the mountain mass that the Mission Range owes the clear separation of features due to local glacial sculpture in the high southern belt from those due to general glacial sculpture in the low northern belt, by the oblique middle belt

of normal sculpture. As far as I have seen and read, the range is unique in this systematic tripartite arrangement of normally and glacially sculptured forms. A fuller account of the range will be prepared for the *Bulletin of the American Geographical Society.*

DEFINITION OF LIMIT IN GENERAL INTEGRAL ANALYSIS

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1. *General Analysis.* The problem of Science is the organization of and the study of the interrelations amongst the objects and phenomena of Nature. Analogous objects or phenomena are grouped into classes. In the progress of Science, with the discovery of new objects or phenomena or interrelations, the bases of classification initially of necessity superficial become more fundamental; thus in Physics, Electricity and Magnetism and later Light merge in Electromagnetism.

Mathematics with its source in Nature progresses in similar fashion. Hence, remembering that the objects or phenomena of Mathematics may be theories (doctrines), we may enunciate the following heuristic principle:

> The existence of analogies between central features of various theories implies the existence of a more fundamental general theory embracing the special theories as particular instances and unifying them as to those central features.

After the development of such a general theory, the fact that the various theories are instances of the general theory implies as an obvious consequence (and accordingly eclipses in importance) the analogies between the central features of the various theories. In illustration of the heuristic principle may be adduced the theories of General Analysis mentioned below.

Analysis is the branch of Mathematics devoted to the classification of and the study of the interrelations amongst numerically valued functions. A (single-valued) function τ or $\tau(p)$ is a table (or rule or process) assigning to every element or member p of a certain class or range $\mathfrak{P}$ a definite element q of a certain class $\mathfrak{Q}$. It is numerically valued in case the functional values $q, = \tau(p)$, are numbers real or complex. Although not always numerical, the independent variable p of a function τ considered in a theory of Classical Analysis is always of specified nature; e.g., the variable p may be a curve or a numerically